

CLAIMS:

1. A chemical vapor deposition (CVD) apparatus usable in the manufacture of superconducting conductor on an elongate substrate, the CVD apparatus comprising:

- a) a reactor;
- b) at least one substrate heater;
- c) at least one precursor supply system;
- d) at least one precursor injector; and
- e) at least one gas composition monitor.

2. The CVD apparatus according to Claim 1, wherein the at least one gas composition monitor comprises a precursor content monitor.

3. The CVD apparatus according to Claim 2, wherein the precursor content monitor comprises an oxygen content monitor.

4. The CVD apparatus according to Claim 3, wherein the oxygen content monitor comprises a solid-state electrode.

5. The CVD apparatus according to Claim 4, wherein the solid-state electrode comprises YSZ.

6. The CVD apparatus according to Claim 1, wherein the at least one substrate heater further includes at least one susceptor.

7. The CVD apparatus according to Claim 6, wherein the susceptor has a radius of curvature for accommodating the elongate substrate.

8. The CVD apparatus according to Claim 1, wherein the substrate heater is a multiple-zone heater.

9. The CVD apparatus according to Claim 8, further including a surface heater.

10. The CVD apparatus according to Claim 9, wherein the surface heater is positioned so as to maintain a temperature at the growth surface on the substrate at a deposition temperature.

11. The CVD apparatus according to Claim 1, wherein the substrate heater is a single-zone heater.

12. The CVD apparatus according to Claim 11, further including a surface heater.

13. The CVD apparatus according to Claim 12, wherein the surface heater is positioned so as to maintain a temperature at a growth surface on the substrate at a deposition temperature.

14. The CVD apparatus according to Claim 12, wherein the surface heater is a lamp.

15. The CVD apparatus according to Claim 1, wherein the substrate heater comprises at least one heat source.

16. The CVD apparatus according to Claim 15, wherein the heat source comprises a plurality of lamps.

17. The CVD apparatus according to Claim 15, wherein the heat source is at least one resistance heating element.

18. The CVD apparatus according to Claim 1, further including a shield for protecting a low-temperature region of the substrate.

19. The CVD apparatus according to Claim 18, wherein the substrate shield is positioned so that the surface temperature over the deposit coating does not exceed the deposition temperature.

20. The CVD apparatus according to Claim 1, further including an exhaust system.

21. The CVD apparatus according to Claim 20, wherein the exhaust system is for removing reaction products from the elongate substrate surface.

22. The CVD apparatus according to Claim 21, wherein the exhaust system is a vacuum system.

23. The CVD apparatus according to Claim 1, further including a gas supply.

24. The CVD apparatus according to Claim 23, further including a mass flow control mechanism.

25. The CVD apparatus according to Claim 23, further including a carrier fluid supplied to the precursor supply system.

26. The CVD apparatus according to Claim 25, wherein the carrier fluid is an inert gas.

27. The CVD apparatus according to Claim 26, wherein the inert gas is argon.

28. The CVD apparatus according to Claim 23, wherein the gas is a reactive gas.

29. The CVD apparatus according to Claim 28, wherein the reactive gas is one of oxygen and nitrogen oxide.

30. The CVD apparatus according to Claim 1, further including a tape handler.

31. The CVD apparatus according to Claim 30, wherein the tape handler comprises a tape translation mechanism.

32. The CVD apparatus according to Claim 31, wherein the tape translation mechanism comprises at least one of a conveyor, reel-to-reel unit, robotic translator, and combinations thereof.

33. The CVD apparatus according to Claim 1, further including at least one controller in communication with at least the substrate heater.

34. The CVD apparatus according to Claim 33, further including at least one sensor in communication with the at least one controller.

35. The CVD apparatus according to Claim 34, wherein at least one sensor includes any one of a flow meter, a species monitor, a filament state monitor, a deposition sensor, a temperature sensor, a pressure sensor, a vacuum sensor, a speed monitor, and combinations thereof.

36. The CVD apparatus according to Claim 33, wherein the at least one controller is for regulating the at least one precursor injector.

37. The tape-manufacturing system according to Claim 33, wherein the at least one controller is for regulating the at least one precursor supply system.

38. The tape-manufacturing system according to Claim 33, wherein the at least one controller regulates a translational speed of the elongate substrate.

39. The tape-manufacturing system according to Claim 33, wherein the at least one controller regulates a translational speed of the elongate substrate.

40. The tape-manufacturing system according to Claim 1, wherein the at least one precursor injector comprises a longitudinal flow distributor.

41. The tape-manufacturing system according to Claim 40, wherein the at least one precursor injector further includes a transverse lateral flow restrictor.

42. The precursor injector according to Claim 40, wherein the longitudinal flow distributor includes an entrance, a receiver volume, a distributor, a distribution volume, and a plurality of exits.

43. The precursor injector according to Claim 42, wherein the entrance is a tube.

44. The precursor injector according to Claim 42, wherein the distributor is a perforated member.

45. The precursor injector according to Claim 44, wherein the perforated member has a density of between about 1 and about 10 holes per inch.

46. The precursor injector according to Claim 42, wherein the distribution volume is less than the receiver volume.

47. The precursor injector according to Claim 42, wherein the receiver volume is greater than a total volume of perforations in the perforated member.

48. The precursor injector according to Claim 42, wherein a total volume of the perforations is greater than the distribution volume.

49. The precursor injector according to Claim 43, wherein there is an equal volume of perforations on both sides of the tube, and the tube is substantially in the center of the injector.

50. The precursor injector according to Claim 49, wherein the volume of perforations increases with an increasing direction from the tube.

51. The precursor injector according to Claim 50, wherein the volume of perforations is increased by increasing the diameter of the perforations.

52. The precursor injector according to Claim 50, wherein the volume of perforations is increased by increasing the thickness of the perforated member.

53. The precursor injector according to Claim 42, further including a vapor delivery.

54. The precursor injector according to Claim 53, wherein a volume of the vapor delivery is greater than the receiver volume.

55. The precursor injector according to Claim 1, further including a temperature regulation system.

56. The precursor injector according to Claim 55, wherein the temperature regulator further includes a plurality of temperature sensors.

5 57. The precursor injector according to Claim 55, wherein the temperature regulation system includes a heat source.

58. The precursor injector according to Claim 55, wherein the temperature regulation system includes a cooler.

59. The precursor injector according to Claim 41, wherein the lateral flow
10 restrictor is a physical extension of the precursor injector.

60. The precursor injector according to Claim 41, wherein the lateral flow restrictor is a gas curtain emanating from the injector.

61. The precursor injector according to Claim 41, wherein the lateral flow restrictor is spaced relative to the substrate heater in a manner to permit exhausting of reaction
15 products from the surface of the elongate substrate.

62. The CVD apparatus according to Claim 1, wherein the precursor supply includes a solid precursor source.

63. The CVD apparatus according to Claim 62, wherein the solid precursor source is a powder.

20 64. The CVD apparatus according to Claim 1, wherein the precursor supply includes a delivery mechanism comprising one of a mill and a conveyor when the precursor source comprises a solid.

65. A precursor supply system usable with a reactor of a chemical vapor deposition (CVD) apparatus in combination with a substrate heater, precursor injector and usable in the manufacture of superconducting conductor on an elongate substrate, the precursor supply system comprising:

- a) at least one precursor source;
- b) at least one a delivery mechanism including at least one assist vehicle;
- c) at least one vaporizer for vaporizing a precursor provided by at least the at least one precursor source; and
- d) at least one vehicle for transporting at least the vaporized precursor from the precursor supply to the precursor injector of the CVD apparatus.

66. The precursor supply system according to Claim 65, at least one assist vehicle comprises an assist fluid.

67. The precursor supply system according to Claim 66, wherein the assist fluid comprises an inert gas.

68. The precursor supply system according to Claim 67, wherein the inert gas is argon.

69. The precursor supply system according to Claim 65, wherein the precursor source is a liquid.

70. The precursor supply system according to Claim 69, wherein the liquid is a solution of THS and thd.

71. The precursor supply system according to Claim 65, wherein the delivery mechanism comprises a pump when the precursor source comprises a fluid.

72. The precursor supply system according to Claim 65, wherein the at least one vehicle comprises a carrier fluid.

73. The precursor supply system according to Claim 72, wherein the carrier fluid comprises an inert gas.

74. The precursor supply system according to Claim 73, wherein the inert gas comprises argon.

75. A chemical vapor deposition (CVD) apparatus usable in the manufacture of superconducting conductor on an elongate substrate, the CVD apparatus comprising:

- a) a reactor;
- b) at least one substrate heater; and
- c) at least one precursor supply system;
 - i) at least one precursor source,
 - ii) at least one a delivery mechanism including at least one assist vehicle;
 - ii) at least one vaporizer for vaporizing a precursor provided by at least the at least one precursor source; and
 - vi) at least one vehicle for transporting at least the vaporized precursor from the precursor supply to the precursor injector of the CVD apparatus;
- d) at least one precursor injector; and
- e) at least one gas composition monitor.

76. The CVD apparatus according to Claim 75, further including a shield for protecting a low-temperature region of the substrate.

77. The CVD apparatus according to Claim 76, wherein the substrate shield is positioned so that the surface temperature over deposit coating does not exceed the deposition temperature.

78. A method for manufacturing a high temperature superconducting conductor, said method comprising the steps of:

- a) providing at least a portion of an elongate substrate to a reactor;
- b) heating the at least a portion of the elongate substrate to a temperature so as to permit the formation of one of a predecessor to a superconducting material and a superconducting material on the at least a portion of the substrate;
- c) providing at least one precursor to the reactor so as to permit the formation one of a predecessor to a superconducting material and a superconducting material on the at least a portion of the substrate; and
- d) monitoring at least one aspect of a composition of a gas in the reactor so as to control the formation of the one of a predecessor to a superconducting material and a superconducting material on the at least a portion of the substrate.

79. A method for manufacturing a high temperature superconducting conductor using a reactor of a chemical vapor deposition (CVD) apparatus in combination with a substrate heater, and precursor injector, the method comprising the steps of:

- a) providing at least one precursor to a vaporizer using at least one assist vehicle;
- b) vaporizing the precursor; and
- c) transporting the at least one vaporized precursor to the reactor so as to permit a formation of formation of the one of a predecessor to a superconducting material and a superconducting material.

80. A method for manufacturing a high temperature superconducting conductor, the method comprising the steps of:

- a) providing at least a portion of at least one substrate heater to a reactor;
- b) heating the at least a portion of at least one substrate heater to a temperature sufficient to permit to permit a formation of formation of the one of a predecessor to a superconducting material and a superconducting material; and
- c) providing at least one precursor to a vaporizer using at least one assist vehicle;
- d) vaporizing the precursor;
- e) transporting the at least one vaporized precursor to the reactor so as to permit a formation of formation of the one of a predecessor to a superconducting material and a superconducting material on the at least a portion of the substrate; and
- f) monitoring at least one aspect of a composition of a gas in the reactor so as to control the formation of the one of a predecessor to a superconducting material and a superconducting material on the at least a portion of the substrate.

81. A high temperature superconducting conductor comprising:

- a) an elongate substrate;
- b) at least one oxide superconductor layer supported by said elongate substrate, and
- c) an I_c of over about 200 A/cm-width.